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ABSTRACT

Tests of conditionability in infants were used in a longidudinal study of 32 subjects in the first year of life. The research was based on Eysenck's hypothesis that conditionability i s a unitary factor related to introversion-extroversion and attention span. The objective of the investigators was to devise a battery of conditioning tasks applicable at ages 3 months, 6 months, 9 months, and 12 months, which would examine individual differences and patterning in conditioning behavior. At each test period, the infant was given four conditioning tasks which were usually repeated on each of three days. Criteria for accepting conditioning tasks included: (1) Is it appropriate for the age? (2) Is it simple to administer? (3) Is it non-aversive to most babies? At each test period, the Bayley Test of Mental and Motor Development was administered, a simple test of attention span was carried out, and the mother was given a questionnaire to fill out and return. Findings include: (1) Test administration is possible without unduly tiring the subjects; (2) Tasks set up for the infants must be simple, pleasureable, brief; (3) Subjects of these ages present some unique problems in that they are not likely to tolerate a bare physical setting and instrumentation; (4) The problem of acclimating the child to the strange setting was speeded by an initial play period with toys; and (5) Continued willingness to participate by the parents is maximized by answering their questions about child development and child rearing philosophy, and in some cases, referrals to proper help. (CK)

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# THE DEVELOPMENT OF A SET OF CONDITIONING TASKS TO MEASURE CONDITIONABILITY AS A STABLE ASPECT OF BEHAVIOR --A FEASIBILITY STUDY*

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## INTRODUCTION

Tests of conditionability in infants were used in a longitudinal study of thirty-two subjects in the first year of life. Thirty-two subjects, representing a random sampling of infants of both races and sexes and of diverse socio-economic backgrounds, were tested on three consecutive days at four test times: ages 3, 6, 9, and 12 months. Tests based on existing methods of successful infant conditioning were adapted and at each test time included eye blink, vocalization, head turn, and discrimination tasks. Tests of attention-span and the Bayley Test of Mental and Motor Development were given at each test time.

Primarily a feasibility study, the research was based on Eysenck's hypothesis that conditionability is a unitary factory related to introversion-extroversion and attention span. This hypothesis is discussed at length in Biological Roots of Personality[1] and in other

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[1]H. J. Eysenck, Biological Roots of Personality (Boston: Houghton Mifflin Co., 1967); H. J. Eysenck, Crime and Personality (Boston: Houghton Mifflin Co., 1964).

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of his writings. A partial summary of Eysenck's hypothesis follows:

There are two basic dimensions of temperament or personality which may be called the dimension of introversion-extroversion and the dimension of emotionality. These dimensions are hereditary, but like all human attributes, may be modified by "environment" to produce

a phenotype which differs from the genotype. Nevertheless, these are strong hereditary predispositions and are relatively unmalleable.

The dimension of introversion-extroversion is linked to a number of other aspects of behavior in addition to the obvious one of being outgoing as opposed to withdrawn. These include attention span (longer for introverts); threshold of tolerance for stimuli (extroverts endure and seek more intense stimuli); and learning style (introverts condition faster and extinguish later).

Basic temperamental introversion-extroversion predicts the individual's facility in being conditioned to observe moral and other behavioral norms (extroverts are more likely to become juvenile delinquents). Basic temperamental introversion-extroversion indicates a best teaching strategy in conditioned learning (extroverts require more repetitions using a stronger stimuli but in shorter conditioning sessions).

The clear implication that there are wide individual differences in conditioning behavior in children and, therefore, that wide individual differences in teaching strategies are indicated seemed to the investigators a premise worth following up in empirical investigation. It seemed reasonable to assume that:

(1) While the personality dimension of introversion-extroversion is difficult to test in early infancy, conditioning performance can be tested. The literature is replete with

accounts of successful infant conditioning.[2]

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[2]Brackbill, Yvonne, "Research and Clinical Work with Children," in Some Views on Soviet Psychology, ed. by R. Bauer. Washington, D.C.: American Psychological Assn., 1962.

Brackbill, Yvonne and Koltsova, M. M., "Conditioning and Learning," in Infancy and Early Childhood, ed. by Yvonne Brackbill. New York: The Free Press, 1967.

Bijou, Sidney W., and Sturgis, Persis T., "Positive Reinforcers for Experimental Studies with Children - Consumables and Manipulables." Child Development, 1959, 30, 151-170.

Gormezano, "Classical Conditioning," in Experimental Methods and Instrumentation in Psychology, ed. by Joseph B. Sidowski. New York: McGraw Hill, 1966.

Sandys, James, "Operant Conditioning," Ibid.

Bair, B. S., "Operant Methods in Child Behavior and Development," in Child Development: Readings in Experimental Analysis, ed. by Sidney W. Bijou and Donald M. Baer. New York: Appleton, Century, Crofts, 1967.

Lipsitt, Lewis P., "Learning in the First Year of Life," in Advances in Child Development and Behavior, ed. by Lewis P. Lipsitt and Charles C. Spiker. New York: Academic Press, 1963.

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(2) The possible effects of a hereditary predisposition would be greatest at an early age, indicating the desirability of testing during the first year of life. Therefore, the objective of the investigators was to devise a battery of conditioning tasks applicable at ages 3 months, 6 months, 9 months, and 12 months which would examine individual differences and patterning in conditioning behavior. In addition, attention span and general mental and motor

development would be examined to see if conditionability was related to any of these. As part of this study the same subjects will be tested at 3 years of age, using a standardized test of I.Q., and at 7 years of age using a standardized test of introversion-extroversion, to see if early conditionability predicts a later measurement on either of these tests. Eysenck's model does not hypothesize a relationship between either attention span or conditionability and I.Q.

Eysenck's hypothesis:

Introversion=Ready conditionability, long attention span, low stimulus tolerance

Extroversion=Slow conditionability, short attention span, high stimulus tolerance

Our proposition:

Ready conditionability=introversion, low attention span, low stimulus tolerance

Slow conditionability=extroversion, short attention span, high stimulus tolerance.

## METHOD

### Pilot Phase

The pilot phase of this study was carried out under a University of Alabama research grant and was devoted to developing a battery of conditioning tasks. Some conditioning tasks that had already been used successfully with infants by other researchers were

used, but some original tasks were developed and tested in this pilot phase.

Insofar as possible, the investigators tried to use conditioning tasks already reported in the literature. Criteria for accepting conditioning tasks were: Is it appropriate for the age? Is it simple to administer? Is it non-aversive to most babies? Can the investigators get the necessary equipment within a limited budget? Is the response discernable and measurable?

Selection of Subjects

Concurrent with final selection of the battery of tasks during the summer of 1969 was the selection of subjects for the study. All births recorded at the Tuscaloosa County Health Department for the months of July, August, and the first half of September, 1969 were entered on 3 x 5 cards. Infants living outside of the city limits of Tuscaloosa were eliminated. The deck of cards was shuffled and telephone recruitment of subjects began. After 15 subjects had been recruited, the list was examined to see if there was a racial or social class bias. Since there did seem to be a bias in favor of white middle-class families who (a) have a telephone and (b) have favorable attitudes toward research, telephone recruitment was abandoned and home visits were used. The final sampling of thirty names was balanced for sex, race, and social class. Two infants were added who seemed likely to represent a low I. Q. group, one because she was a Mongoloid and one because both parents were retarded.

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The starting group of 32 was felt to be sufficiently large to allow for attenuation.

Each infant was brought in by the mother for three successive mornings at each test period. No money compensation was available, but transportation was furnished if the family had no car, which made it possible to keep a number of low income infants in the project. The mother and the infant were always welcomed and made to feel that they were making a worthwhile contribution. The first five minutes of each test period was devoted to free play and social interchange with the mother and infant by the examiner.

At each test period the following procedures were observed. The infant was given four conditioning tasks which were usually repeated on each of three days. At each test period the Bayley Test of Mental and Motor Development was administered, a simple test of attention span was carried out, and the mother was given a questionnaire to fill out and return.

The general design of the test room, which is in itself an important item, went through three stages during the year. In Stage I (age 3 months) a vacant room was used with minimal and very crude instrumentation which was visible at all times. The infant either lay in a crib or was propped up in an infant seat or, if necessary, was held in the mother's lap. The examiner, recorders, and observers were present in the room.

In Stage II (ages 6 months and 9 months), acting on suggestions from our consultant, Dr. Herbert Kaye, distracting stimuli

were blocked out by building a series of test cubicles, each separately wired and curtained off and the whole room painted white. While this layout looked more professional and did aid in eliminating distractions, it was more aversive to the subjects.

In Stage III (age 12 months) a new room with an entirely different layout was used. It had as much of the test machinery as possible back of a barrier wall, and was more pleasant in appearance and gave more freedom. Observers were stationed behind the baffle wall and viewed the testing through a one-way mirror. The room was approximately 10 feet square, had air conditioning and a soft rug so that the baby could crawl or walk freely. The mother sat in a chair in the room which seemed to make the subjects feel more secure (see Figure 1).

The Bayley test was administered in a different room, furnished only with a small table for administering the test and chairs for mother and examiner.

At each test period, testing was carried on over an 8 weeks period. Two subjects were scheduled for Monday through Wednesday mornings and two more subjects for Wednesday through Friday mornings, making Wednesday a double load day.

Three people, plus a Bayley tester who was present on three days each week, were considered a full testing staff. Most of the time one or more additional staff members were present to answer the telephone, transport subjects and deal with waiting mothers.

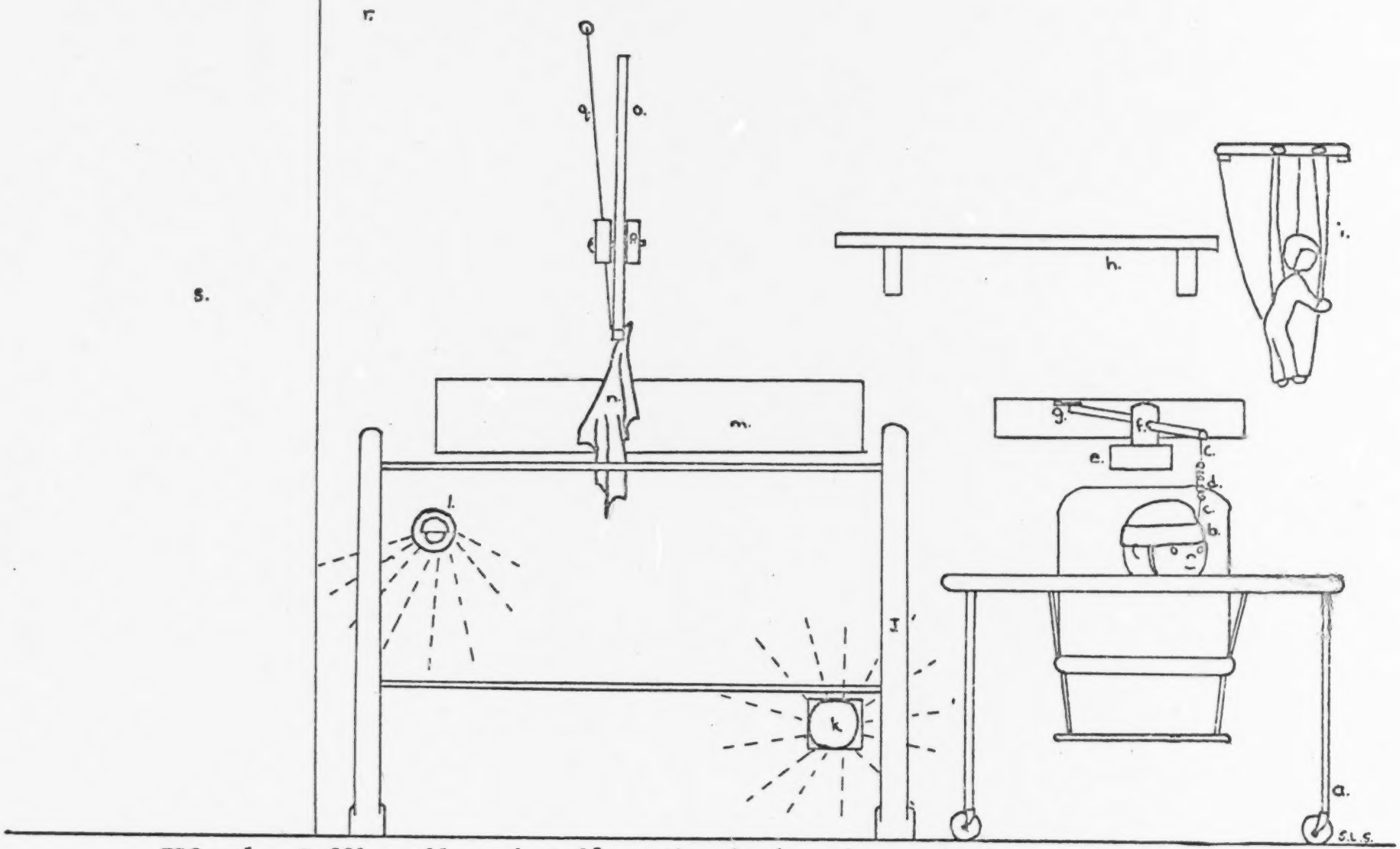


FIG. 1. Baffle wall used at 12 months showing placement of apparatus.

a. infant seat and table
b. headband and chinstrap
c. string
d. spring
e. pivot block
f. swinging arm
g. plate for interuption of cells
h. shelf for toys
i. doll for head turn experiment
j. plexiglass screen
k. sound source
l. Light source
m. oneway mirror
n. handkerchief
o. swinging arm
p. moveable support arm
q. string
r. barrier wall
s. door to control room (baby seat and three-sided screen not shown.)

Setting Factors

Control of variables involved making decisions on many points. In each case the value of keeping the child happy enough to complete testing had to be weighed against the value of keeping procedures uniform. The value of modifying procedures to accommodate individual differences had to be weighed against the value of uniform procedures; e.g., the infants' toleration of noise varied so that some children responded well only to a loud noise while others could not tolerate a loud noise. Was it better to keep a moderately loud noise, thus eliminating the children at the extremes of noise tolerance? Or was it better to accommodate the noise level to the child's tolerance level in order to maximize the chance of getting data on each subject's conditioning rate? In general, the experimenters felt that since a focus of concern in this research was individual differences, the noise level should be lowered until it could be tolerated by the child, but a record kept of these changes. A consistent difference was found in the subjects' ability to tolerate confinement, noise, strangers, testing, and many more attributes. In general, the investigators tried to accommodate procedures to the most sensitive subjects.

Other decisions involved:

What criteria of behavior would determine when a child was sufficiently awake and happy to be "testable"? What criteria would determine when a child's test period should be terminated because of restlessness, illness, sleepiness or evident unhappiness?

If the subject resisted being placed in a jump seat or infant seat, under what circumstances would he be put in the mother's or experimenter's lap? Generally, the subject was placed in the seat and the situation changed when necessary to facilitate the child's continuation in the testing. In cases where the situation had to be changed, the fact was noted. It was felt that this type of comment contribution to an understanding of the child's total learning pattern.

While the investigators were able to make some general observations about the effectiveness of different reinforcers for the group as a whole, some of the subjects were clearly uninterested in reinforcers which were effective with others. When the reinforcers planned for a given conditioning procedure was clearly aversive for a given subject, the reinforcer was changed. Again, the overriding consideration was considered to be that of exploring fully the range of individual differences which affect teaching strategies.

Some subjects were indifferent to the presence of the mother and some were untestable without the mother at the three and six month level but all experimental and nine of the ten control subjects needed the presence of their mother or a mother substitute at the twelve month level. The policy was to have the mother present but seated quietly and unobtrusively to one side throughout testing.

## PROCEDURE

The following section gives a description of procedures used at each test period with comments about the feasibility of each. For those conditioning tasks where extinction was included, extinction was started on any day that criterion was reached. The extinction phase terminated the task (see Schedule of Procedures, Appendix A, for procedures on each day for the test periods).

### Three Months

Eye blink--The infant was placed prone in a crib with a plexiglass shield over his face. A hand buzzer was sounded by the examiner at 3 second intervals until the subject failed to blink to five consecutive tones. Then the tone was synchronized with the release of a muslin parachute held by another examiner. After three pairings of tone and drop, the tone alone was sounded and blinks to these "probe" trials of tone alone were recorded. Five blinks out of 10 probes were considered criterion. This task was repeated each day for three days unless criterion was reached and the extinction phase completed earlier.

Sequence:

Tone alone - blink
Tone alone - no blink
Tone alone - " "
Tone alone - " "
Tone alone - " "
Tone alone - " "

If no blinks:

Tone-drop
Tone-drop
Tone-drop
Tone alone (Probe 1)
[Repeat 10 times]

Eye blink conditioning using parachute and buzzer was easy to use, easy to tally and not aversive to most subjects. Eye blink procedures throughout were suggested by, but not identical with, those of Burton T. White.[3]

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[3]White, Burton T., "Child Development Research: An Edifice Without a Foundation," Merrill-Palmer Quarterly, 1969, 15, 51-79.

White, Burton T., and Riley, Kitty, "An Apparatus for Eliciting and Recording the Eyeblink Response in Human Infants." Unpublished manuscript.

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Vocalization--The infant was placed prone in a crib with only the examiner visible to the infant. Three minutes of baseline unreinforced vocalization were recorded, twice on the first day. Social reinforcement during which the examiner smiled, touched the child on the stomach, and said, "Good boy," every time the infant vocalized, was recorded twice on the second day.

Vocalization procedures were adapted from Rheingold.[4]

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[4]Rheingold, Harriet L., Gewirtz, Jacob L., and Ross, Helen W., "Social Conditioning of Vocalizations in the Infant," in Child Development: Readings in Experimental Analysis, ed. by Sidney W. Bijou and Donald M. Baer. New York: Appleton-Century-Crofts, 1967, pp. 47-58.

On the third day a reinforced vocalization period was followed by a nonreinforced extinction period.

Vocalization involves a minimum of instrumentation but a maximum of recorder decisions. Defining readiness to be tested, a unit of vocalization, and the kinds of vocalization to be tallied were complicated decisions. Whines, cries, laughs or grunts were not considered vocalizations. A sensitive microphone and tape recorder are helpful in obtaining reliable data.

Head turn--The examiner was seated in a chair holding the infant on her lap so that the infant faced a blank wall. A screen blocked distractions on three sides. Door chimes which were sounded for one second were used as a cue and sucking on a bottle of milk for three seconds, if the infant turned right, was used as reinforcement. If the infant did not turn his head spontaneously within 10 seconds after the bell the turning response was shaped by touching the right cheek with the nipple and leading his head to the right. Ten trials were used on each of three days unless the infant met criterion earlier. If the infant met criterion (five spontaneous right turns following the chimes), the reinforced side was changed to the left side. If criterion was met on this side, 10 extinction trials were administered.

This procedure was tolerated by most subjects but subject had to be neither hungry nor satiated. Head turn procedure was

suggested by the work of Papousek.[5]

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[5]Papousek, Hanus, "Appetitional Behavior in Human Infants," in Early Behavior, ed. by Harold W. Stevenson, Eckhard H. Hess, and Harriet L. Rheingold. New York: John Wiley and Sons, Inc., 1967, p. 270.

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Discrimination box---The infant was placed prone in a crib with a plywood box covering half of the crib. Two lights in the top of the box were wired so that either could be activated, lighting a clown's face. The examiner peered through a 1/2 inch hole in the top to determine to which light the infant's gaze was directed. Looking at one of the lights resulted in its being activated but looking at the other had no effect. This device was suggested by John Watson's work.[6] This task produced so much protest behavior

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[6]Watson, John S., "Memory and "Contingency Analysis- in Infant Learning," Merrill-Palmer Quarterly, 1967, 13, p. 58.

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that it had to be discontinued and there was insufficient data to be of any value. The infants seemed to dislike the semi-darkness and the partially enclosed box.

Attention span--The subject was placed prone in a crib. The examiner held a 4" red ring 10" above his face while two observers stationed at either side of the crib clocked the amount of time subject focused on the ring. The same procedure was used with a 12 x 16 inch mirror held over his face and also with the

examiners bending over until her face was 10" above the subject's face. This procedure was easily administered and well received by the subjects.

Six Months

Eye blink--As indicated in Figure 2, the subject was placed prone in a crib with a plexiglass shield over his face. A tone produced by an oscillator was sounded until the subject failed to blink to five consecutive tones. Then the tone was synchronized with the release of a muslin parachute syspended from a mechanical micro-switch apparatus over the subject's face. The drops were programmed by a punched tape and averaged 2-3 seconds apart. After three pairings of tone and drop, the tone alone was sounded and blinks to these "probe" trials of tone alone were recorded. Five blinks out of 10 probes were considered criterion.

Eye blink conditioning was not aversive under these conditions:

ITI less than 5 seconds.

Machine drop with buzzer soft in tone.

Subject not placed in anything which resembles a box, so that subject is able to look out during acquisition (this does not interfere with acquisition of blink and adds to his tolerance of the procedure).

Vocalization--The infant was placed in a playpen with an appealing toy in a completely bare room by himself for three minutes for unreinforced vocalization. Two observers tallied his vocalizations

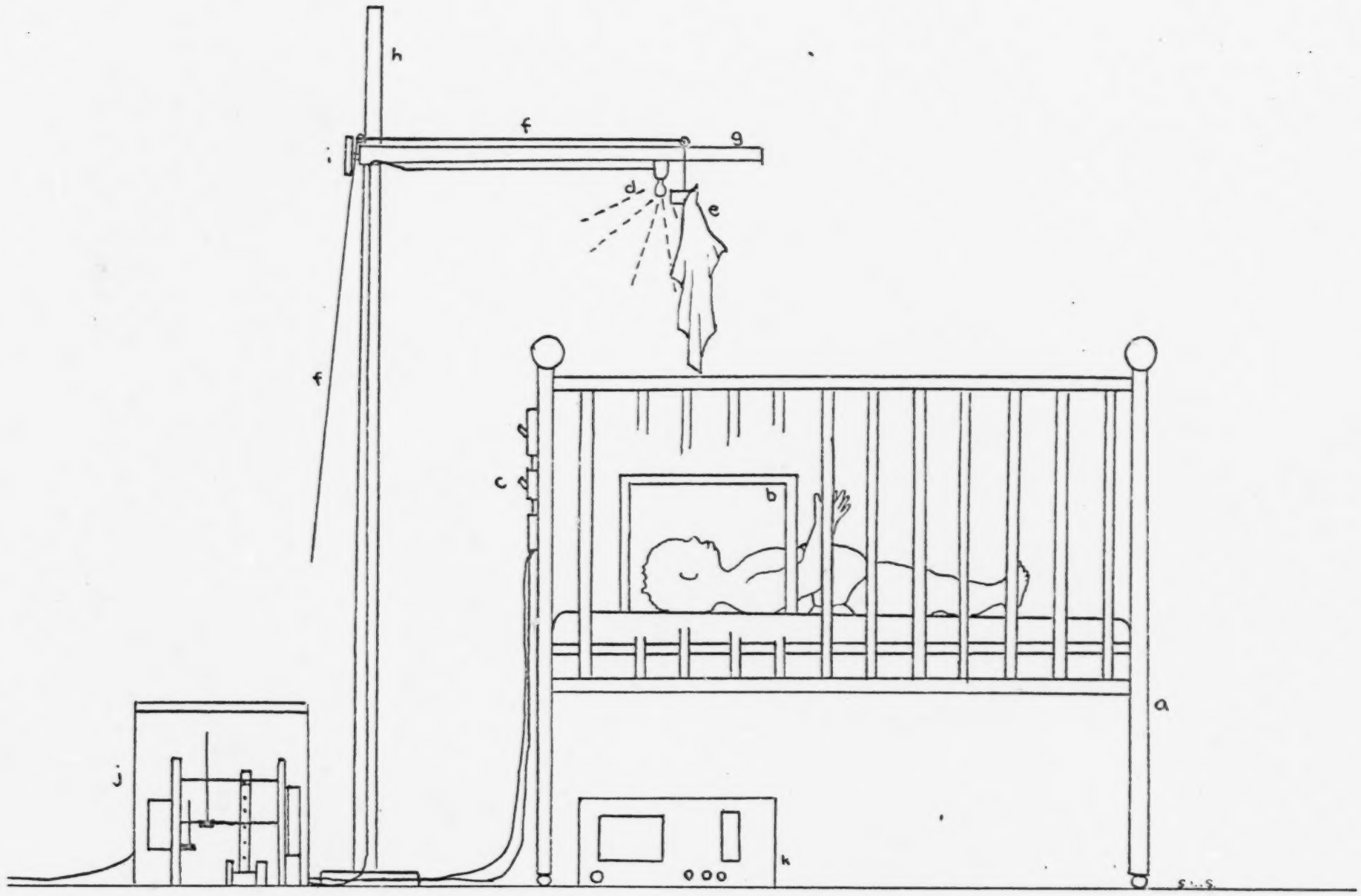


Figure 2. Eye blink conditioning apparatus using "parachute" drop.

a. crib
b. table with plexiglas top
c. control panel
d. light source
e. handkerchief with weight
f. string
g. support arm
h. pole for support arm
i. handle for adjusting height of support arm
j. tape punched to program randomly spaced rings and drops
k. oscillator sound source

from an adjoining room. One Day I, following the unreinforced period, vocalization was reinforced for 3 minutes with each of these:

social reinforcement as at 3 months
mirror
music box
manipulative toy

At six months, the subjects seemed to be interested in the mirror, music box, and a manipulative toy, but not in social reinforcement. Procedure repeated on Day II.

Head turn--The subject faced a semicircular screen (see Figure 3). When he turned his head to the left a picture was projected on the screen to his left, slowly moved to center and was then turned off. Every left turn was rewarded by a rotating picture. An arrangement of photoelectric beams behind the child's head was rigged to record the turns on an Esterline Angus Recorder. However, every attempt to affix an object that would be light in weight and which would extend out from the child's head to intercept the beam was unsatisfactory. The most satisfactory arrangement was having two observers to record right and left head turns.

Using head turns in a purely operant design at six months was possible under these conditions:

Infant seated in a walker.

Reinforcement immediate. Exposure of 1 (not more) colored slide which promptly moved to a direct front position in order to reinforce the next head turn. If return to 'start' position was delayed as much as

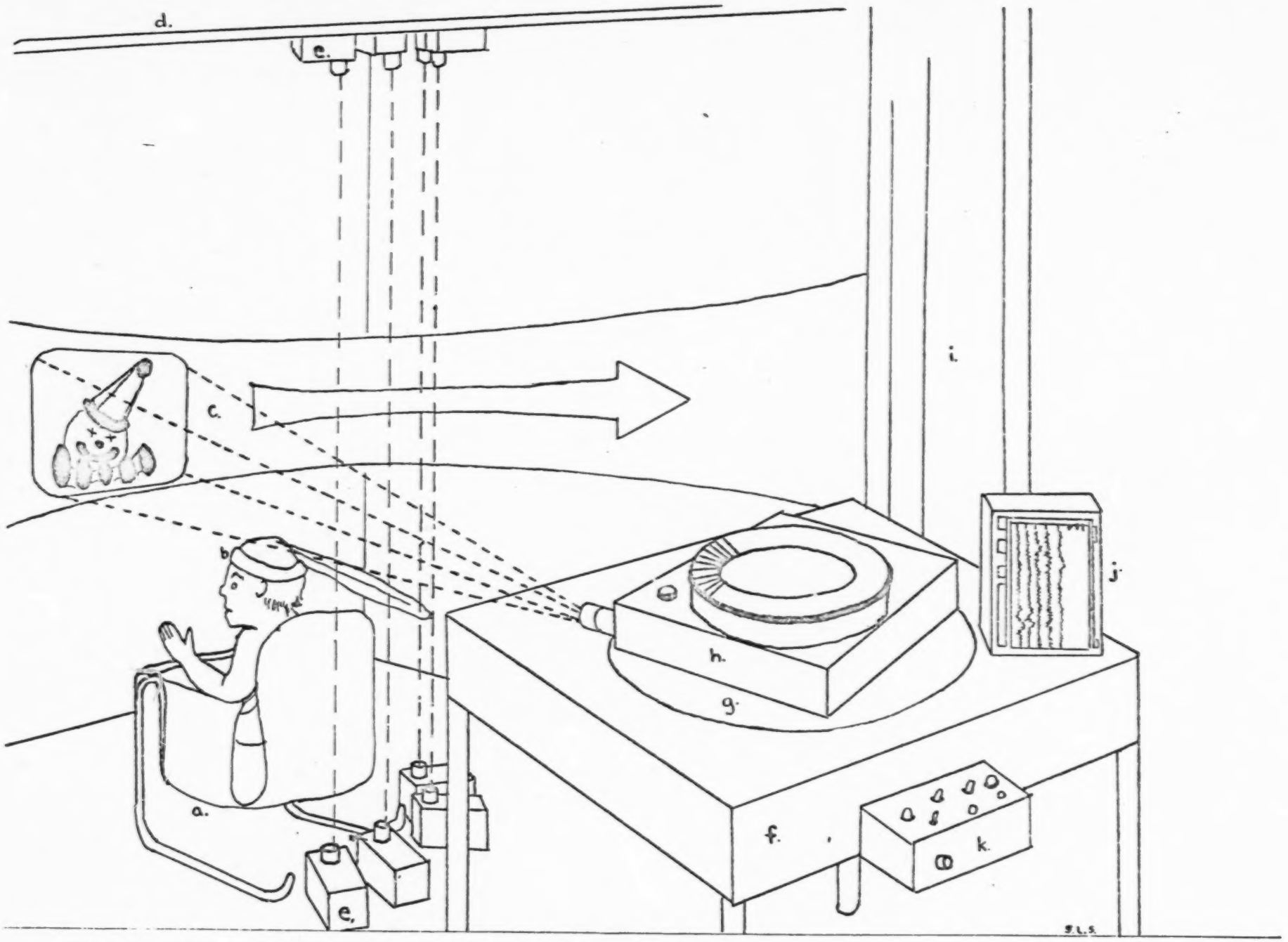


FIG. 3, Head turn apparatus using rotating slide projector.

a. infant seat
b. cap and feather to interrupt photo electric cells
c. curved viewing surface
d board supporting cells
e. photo electric relay systems
f. table
g turn table
h. picture projector
i. curtain to close off room
j. Esterline-Angus recorder
k. control panel

3-5 seconds, the delay in reinforcement was aversive and frustrating. Child satiated usually in 3-6 minutes. Measurement of head turns was complex at this age, and the investigators are still checking out intercepted beam devices. The possibility of using a sensitized movement detector sheet was explored and abandoned because of the difficulty of distinguishinging head turns from head nods.

This procedure was more successful at 6 months than at 9 months, probably because separation from the mother elicits, as would be expected, more protest at 9 months.

Cube discriminations--Ten trials with two colored cubes were used. The yellow cube was sugar coated while the red cube was uncoated and glued to the tray. The position of the cubes was reversed for each trial. The tray was removed from the subject's left and always reappeared from the right. The subject was seated in a jump seat in a cubicle with a curtain in front. The experimenter sat in a low chair in front of the subject to present the tray which was handed through a curtain. The subject was allowed to chew the sugar cube for 3 seconds when this one was picked up. Two observers recorded which cube he reached for first on each trial.

This was easy to administer and tally and well liked by most of the six month olds. One similar task proved less effective--colored cloths, one of which was soaked in a sweet solution. The

task was inspired by Ling using colored cloths.[9]

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[9]Ling, B. C., "Form Discrimination as a Learning Cue in Infants." Comparative Psychological Monographs, 1941, 17, No. 2, 66.

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Attention span--The subject was seated in a walker in a plyboard box 4' x 4'. The front door contained a one way mirror through which two observers clocked the number of seconds until subjects focused on the object which was lowered through a trap door in the top and the amount of time he fixated on the object. The objects were (in order of appearance): a small lighted head of a mouse, a mask, and a metronome (see Figure 4).

Unexpected Findings at Six Months

Laugh response--Some babies laughed when a parachute suspended over the face was dropped.

Right-hand reach at age six months--Subjects show a clear preference for reaching with the right hand and for an object on the right side rather than on the left side. Only one subject made an initial reach to the left and this infant was said by the mother to be definitely left-handed.

Nine Months

Eye blink--Same procedure as at 6 months (see Figure 2).

Two strong disadvantages of this mechanical programmed procedure at the nine months period were: (1) subjects objected to

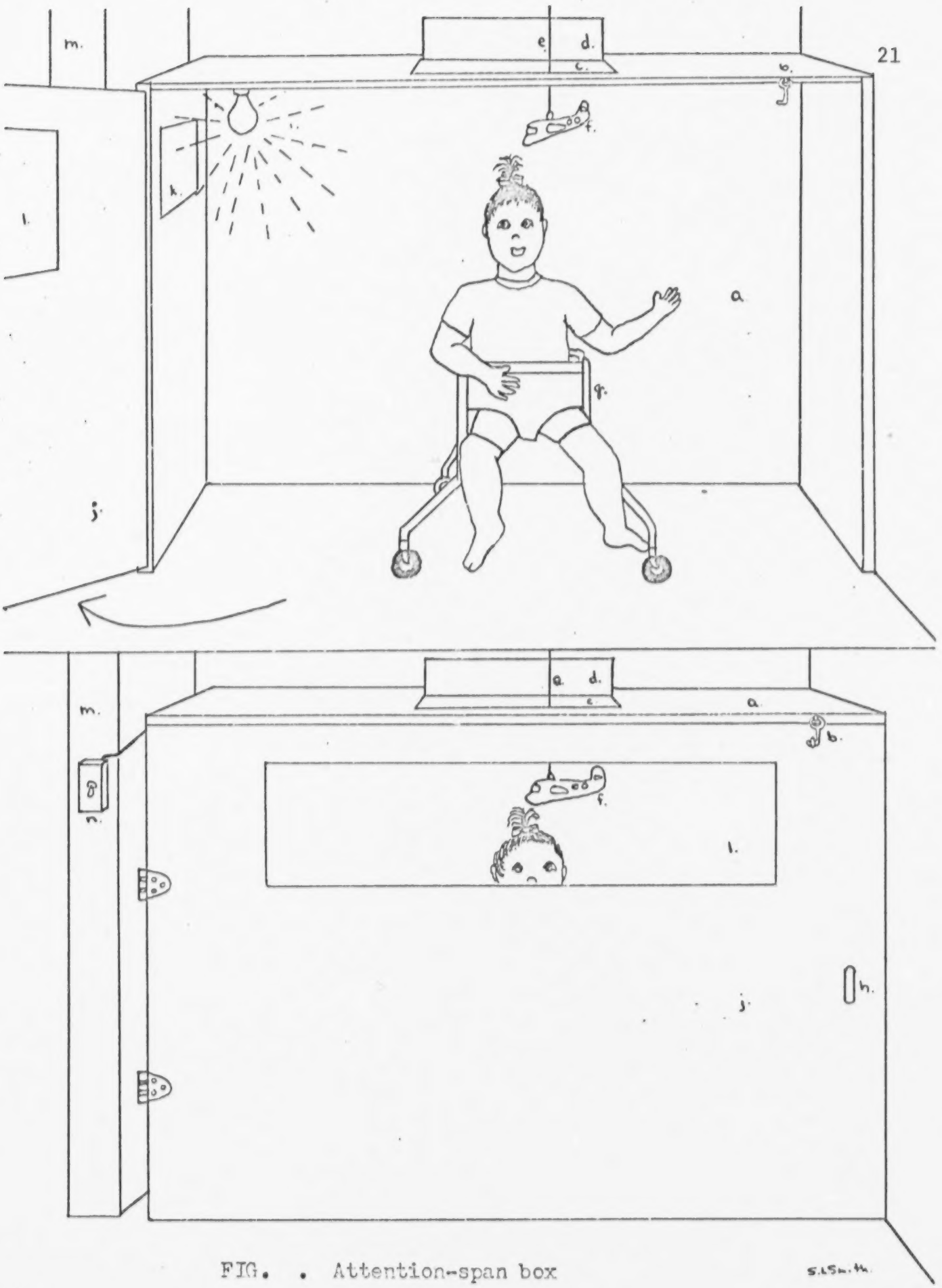



FIG. . Attention-span box

S.L.Sm.th.

a. large box
b. latch
c. hole in ceiling
d. trap door
e. string from toy to observer's hand
f. toy
g. infant seat
h. handle
i. light source
j. door
k. one way mirror with window in barrier wall
l. second one way mirror
m. barrier wall
n. light control

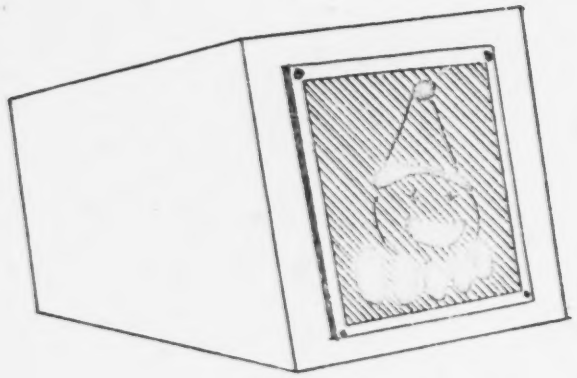
being restrained in a prone position and (2) it was necessary to keep subject's attention fixed on the glass. The timing of the drops and tones was, therefore, often accomplished more efficiently by manual control of the tone-drop sequence than by mechanical control.

Head turn--The head turn procedures were the same as for six months.

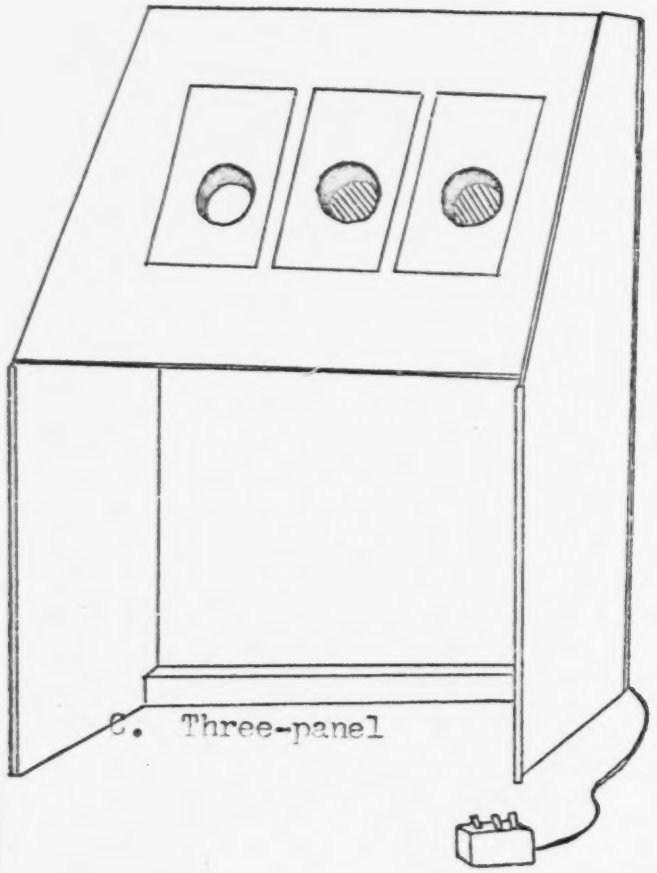
Most subjects objected to being separated from their mothers and being placed in a cubicle facing away from the room. It is possible that this procedure was too mature for the nine-months-old, as some pilot subjects fourteen and fifteen months old performed satisfactorily in a later test.

Vocalization--A baseline rate for unreinforced vocalization was recorded for 3 minutes on the first two days. This was followed by reinforced vocalizations for a total of 12 minutes. Reinforcements used were: social reinforcement, mirror reinforcement, music box reinforcement and food (Cheerio) reinforcement (three minutes each).

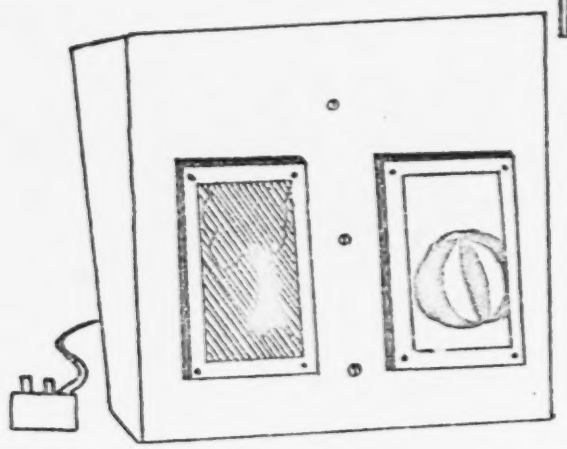
One panel press box--The subject was seated in a playpen facing a 12 x 15 inch wooden box (see Figure 5a). In the center of the box surface facing the subject, a colored cellophane clown's face was affixed to a milk glass panel (8 x 10 inches). When the panel was pressed, a light inside triggered a door chime which made a pleasant two-tone chime sound. The subject was introduced to the box by the experimenter who demonstrated the press motion 3 times. Thereafter, the experimenter tapped but did not press the panel. The box was wired to an Esterline Angus Recorder to record press rate.



A. One-panel



C. Three-panel



B. Two-panel

Figure 5. Panel press boxes of increasing complexity.

The total number of successful presses in a three minute interval were also hand tallied. This was a simple reinforcement procedure similar to a Skinner box and well liked by most all of the subjects.

Ring discrimination--The subject, seated on his mother's lap, was placed in front of two four inch plastic rings suspended from a wooden frame. If the child grasped the left (red) ring, a light directly in front of him turned on and simultaneously a tune played on a music box. Grasping the right (blue) ring was not reinforced. The child was given ten opportunities to grasp a ring as two observers recorded which ring was grasped first on each trial. Five successive reaches to the left (red) ring was considered criterion. This was a simple discrimination problem inspired by Friedlander[10] who used two lamps as reinforcement. It was easy to administer, non-aversive, and suitable for the nine month age.

[10]Friedlander, B. Z., "Automated Measurement of Differential Operant Performance," in Advances in Child Development and Behavior, ed. by Lewis P. Lipsitt and C. C. Spiker. New York: Academic Press, 1963, p. 186.

Attention span--The subjects were placed in a walker, in the enclosed box used for the six month test and the same procedure adopted for this age with the attention span objects being changed. For this age, in order of use, a 4" hand bell, a 6" doll, and a red and yellow plastic camel (moving) were presented. Observers had no difficulty in determining when eyes were fixed on the object and when

they left the object at which time attention was defined as having terminated.

Twelve Months

See Figure 1 for a diagram of the test room.

Eye blink--Eye blink conditioning was used on each day for three consecutive days. The subject was seated in a jump seat facing a plexiglass shield on a stand (see Figures 1 and 6). A 450 Hertz Sine-wave tone, controlled by an oscillator, was sounded for 1 second at 2-3 second intervals until the subject failed to blink five times consecutively to the tone alone. Then the tone was synchronized with the drop of a red parachute affixed to a vertical moving wooden arm and with the turning on of a light (25 watts). Three parachute drops were presented with this synchronization and then the tone alone was sounded. This sequence was followed for 10 trials (thirty pairings and ten probes). Blinks on the probe trials were recorded by an observer viewing through the one-way mirror and the examiner who was present in the room with the subject.

Several problems were encountered with this conditioning task. One was keeping the child's gaze straight ahead on the plexiglass shield. In addition to the light, a small bright toy was used as an attention getter. An assistant sitting behind the shield facing the child was another device employed. The light was the most successful of these attention-getting devices. A second problem was that many 12 month olds resisted any task which involved enforced sitting. Other

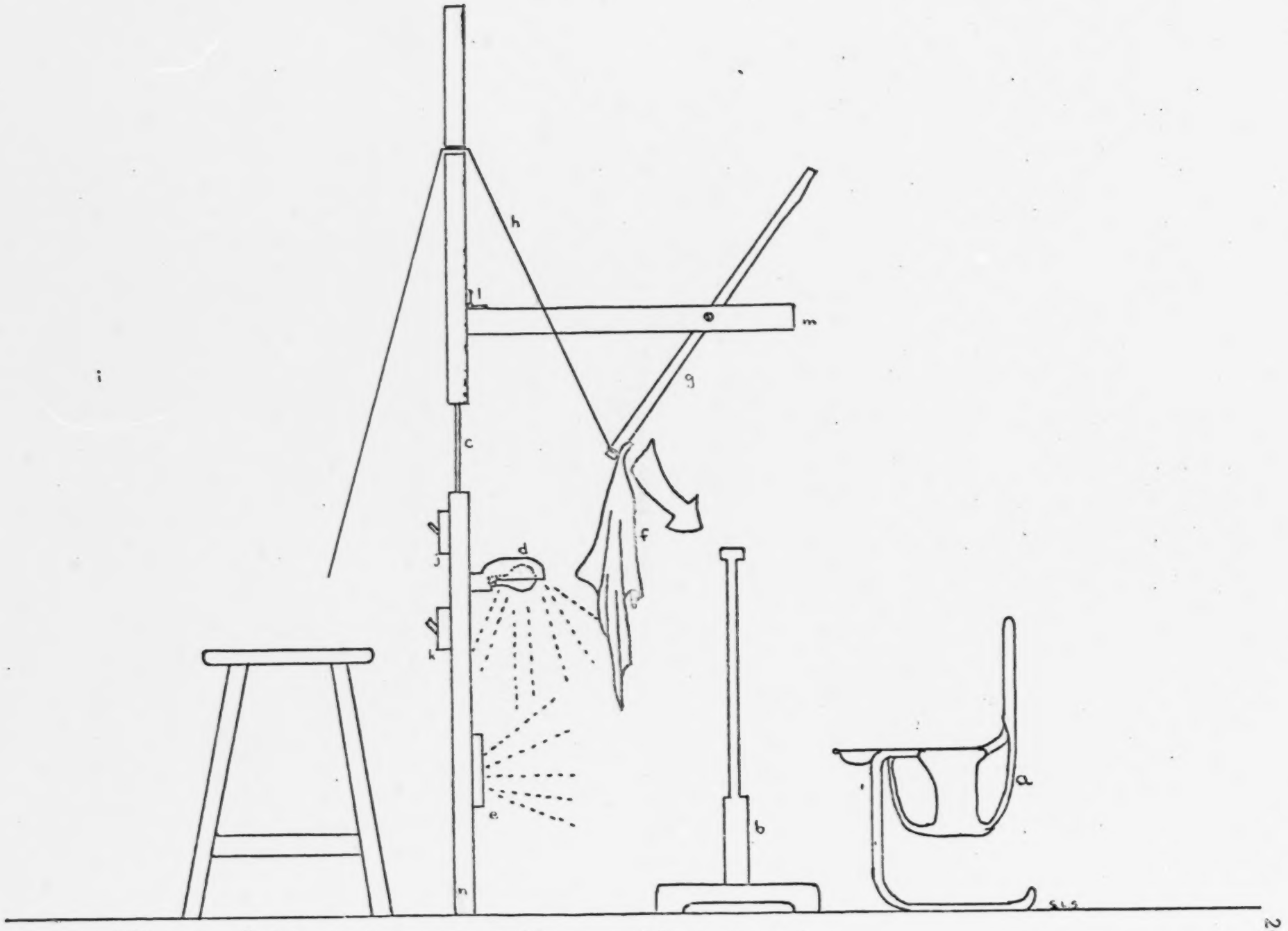



FIG. 6. Baffle wall, cross section, eye blink apparatus.

a. infant seat
b. plexiglas screen
c. one way mirror
d light source
e. sound source
f. handkerchief
g. moveable arm
h. string
i. control room
j. switch for sound
k. switch for light
l. hinge
m. moveable support arm
n. barriar wall

problems were that many subjects tired of the task before completion and some subjects found the procedure aversive. An optional but potentially successful technique was introduced which was a hand puppet tapping on the plexiglass at the sound of the buzzer.

Head turn--The subject was seated in a baby-tenda seat facing a screen about four feet high (see Figures 1 and 7). Three shaping trials preceded the recording of data on head turns. When a buzzer sounded the child's gaze was attracted to the left side of the screen by the experimenter. Immediately after he turned left, a marionette was introduced at left and made to walk to the center of the table, where he raised his hand and was made to say "That's good, _____." The marionette then disappeared over the screen at center position and the experimenter asked "Where did he go?" When the buzzer sounded after the shaping trials, the experimenter waited for ten seconds for a spontaneous turn. If a spontaneous turn occurred, the marionette appeared. If not, the experimenter attracted the subject's attention to the left and then introduced the marionette. The marionette was not introduced on the third day if there was no spontaneous turn. Spontaneous right and left turns by subject after the buzzer were tallied. Ten buzzes constituted one session and the procedure was repeated each day for three days. Five out of ten consecutive spontaneous left turns constituted criterion. If criterion was reached, the reinforced side was changed from left to right. Shaping was repeated on the right. If criterion was reached on the right, ten extinction trials were executed.

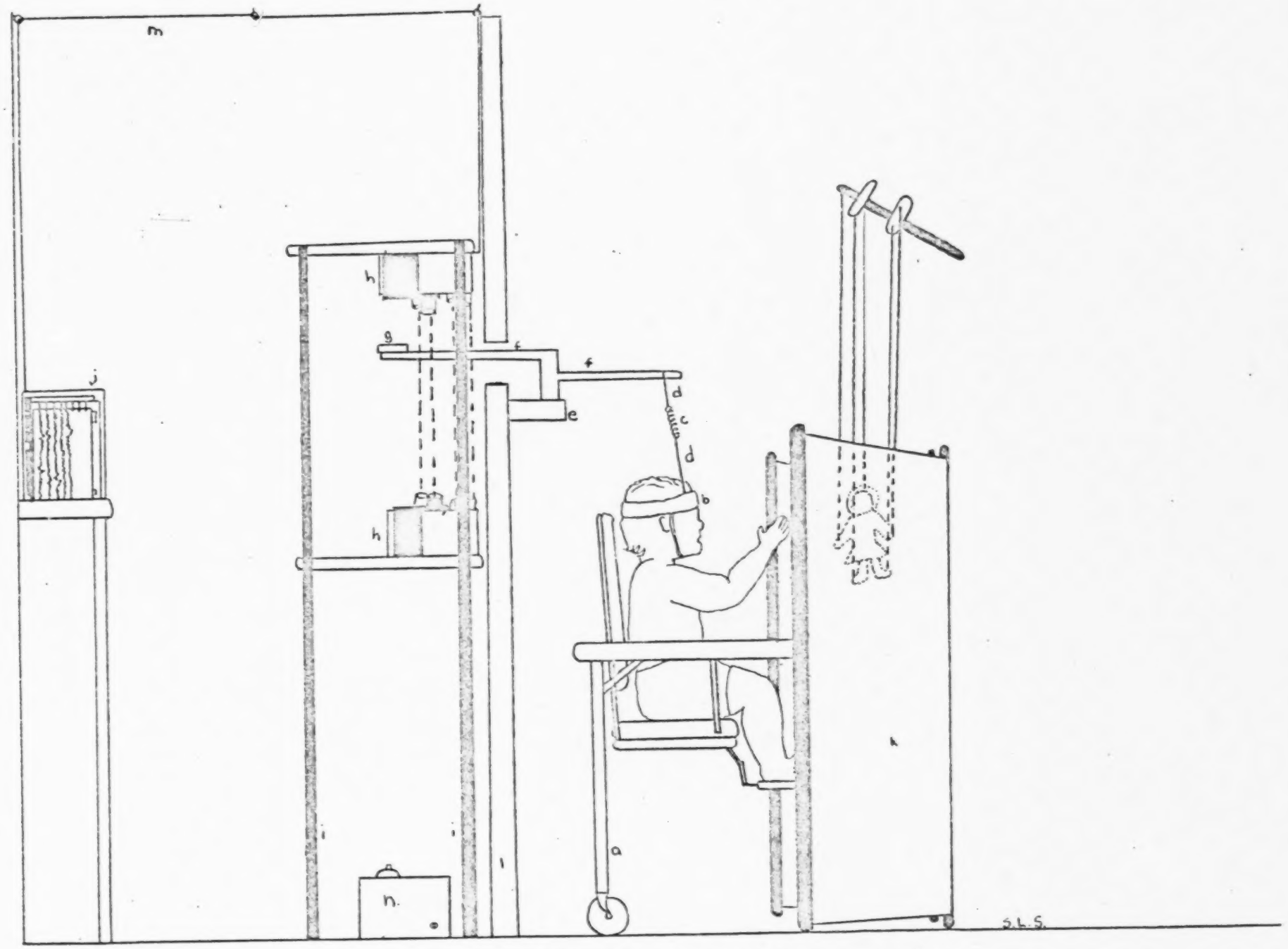



FIG. 7. Cross section view of head turn apparatus.



a. infant seat and table
b. chinstrap and headband
c. spring
d. string
e. pivot block holding bearing
f. swinging bar
g. plate for interrupting cells
h. photo electric relay systems
i. poles supporting cells
j. Esterline-Angus recorder
k. screen
l. barriar wall
m. wires for cells and recorder
n. buzzer in box

An effort was made to record head turns instrumentally (see Figure 7). A metal arm on a bearing was affixed to the barrier wall over the child's head. The metal arm extended to a circle of photo electric beams behind the wall which recorded turns of 30 and 45 degrees to the right or the left. The design called for placing a soft headband around the subject's head with a piece of strong nylon fishline connecting the headband to the moving arm. Since the subjects resisted wearing the headband, other methods were tried, including attaching the string to a small bow or barette in the subject's hair. None of these methods were amenable to the subjects, so this remained an unsolved problem. Two observers recorded turns using a foot pedal connected to the Esterline Angus. Using the buzzer as a cue to turn left seemed to be an alerting signal which facilitated conditioning and simplified tallying.

Vocalization--Vocalizations were tallied on three days. On Day I, three minutes of nonreinforced vocalization would be recorded to get a baseline rate. This was followed by social reinforcement using a monkey hand-puppet and by food (Cheerio) reinforcement. On Day II, the procedure was the same as on Day I, and, in addition, music box reinforcement was introduced. All three of these were found to be satisfactory reinforcements. Music box reinforcement and no reinforcement were repeated on Day III.

Two Panel Press Box

Two panel press box--The two panel press box is an adaptation of a procedure used by Lipsitt and Simmons.[11]

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[11]Simmons, M. W., and Lipsitt, L. P., "An Operant-Discrimination Apparatus for Infants," Journal of Experimental Analytical Behavior, 1961, 4, 233-235.

Simmons, M. W., "3 Panel Press Box," in Advances in Child Development and Behavior, ed. by Lewis P. Lipsitt. New York: Academic Press, 1963, p. 181.

Fenster, C. B., and DeMyer, Marian K., "A Method for the Experimental Analysis of the Behavior of Artistic Children," American Journal of Orthopsychiatry.

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For this task, on Day I, the subject was seated on the floor facing a 15 inch square wooden box (see Figure 5b). On the face of the box were two six by eight inch milk glass panels which covered color transparancies of appropriate pictures (ball and dwarf). A remote control switch enabled the experimenter to activate either panel. When the right hand panel was active a right hand press triggered lighting up of the right picture. The experimenter first pressed each panel three times to demonstrate that one was active and one was not. Then the child's hand was placed on each panel and pressed three times. The subject's presses were then tallied over a three minute period by a wire to the Esterline Angus Recorder which recorded right and left presses. Five consecutive presses of the reinforced side were considered criterion and the R-plus side was changed by the remote control switch. The panel box was non-aversive, simple to administer and interesting to most subjects.

The WGTA--This procedure, modeled on that described by Weisburg,[12] is a discrimination problem. The WGTA box contained a

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[12]Weisburg, Paul and Simmons, Mae W., "A Modified WGTA for Infants in their Second Year of Life," Journal of Psychology, 1966, 99-104.

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pull-out shelf with two holes, each with a sliding cover. The reinforced hole was marked by a small red heart affixed to a wooden block behind the hole. The experimenter sat behind the box and raised a front door which enabled the subject to get to the covered holes, one of which contained a checker. The mother held the subject on her lap and further reinforced finding the checker by saying "There it is!" when the subject opened the correct hole. After each trial, the experimenter lowered the door to put another checker in place. When the subject opened the reinforced side twice consecutively, the red heart was moved and the reinforced side changed. If the subject reached for the new reinforced side twice consecutively, the reinforced side was again changed. A successful first reach to the new side concluded the sequence.

Sequence:

2 consecutive L reaches

Change sides

2 consecutive R reaches

change sides

1 L reach

This, too, is a simple, clear procedure, interesting to most subjects this age. After trying candy, a grape, a piece of cracker and other reinforcements, the checker was found to be the most liked by the subjects, as well as the neatest to administer.

# FINDINGS

## Methodological

The investigators are painfully aware of the difficulty and complexity of designing a set of conditioning tasks appropriate for each of four age periods with all the necessary control of variables, the design and construction of machinery and the search for reliable (preferably mechanical) methods of recording data. This initial project should be thought of primarily as a feasibility study rather than one which attempts to set up a finished methology and set of instruments. Regarding feasibility, the experimenters made the following observations:

1. Administering a battery of four or five conditioning tasks to infants aged three through twelve months on three consecutive days is possible without unduly tiring the subjects.

2. Subjects of these ages present some unique problems. The physical setting and instrumentation so effective with helpless neonates are not likely to be tolerated by the older infant.

   a. He recognizes his mother and does not wish to have her leave. He is aware of strangers and the strange settings. He is not old enough to comprehend explanations. For example, in a Russian measurement of head turning with preschool children, the subject

was coaxed to wear a helmet-like device because it ". . . was like Yuri Gagarin and the spacemen wear."[13]

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[13]Brackbill, Yvonne and Koltsova, M. M., "Conditioning and Learning," in Infancy and Early Childhood, ed. by Yvonne Brackbill. New York: The Free Press, 1967, p. 237.

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b. The infant cannot be satisfactorily restrained in any position nor will he tolerate objects affixed to his body for measuring purposes. He dislikes being shut in a box, cubicle or other enclosed space, and fears unusual noises and machines. He tires easily and is often hungry or sleepy. At age three months the subjects usually slept and/or were fed at least once before completing a test period. He has lost most of his reflex responses but cannot yet manage tasks that involve problem solving or reasoning beyond the simplest level.

3. Tasks set up for the infant, therefore, must be simple, pleasureable and brief. Intertrial intervals must be brief or he loses interest. Perceptiveness and flexibility on the part of the experimenter is essential at this age in order to sense and maximize the time when the infant is relatively calm and happy, i.e., testable.

4. The problem of acclimating the child to the strange setting was speeded by an initial play period with toys believed by the experimenters to be interesting to the particular age

of the infant being tested. For some subjects acclimating, as evidenced by smiling, babbling, handling objects, moving freely around the playpen or room, took much longer than for others.

5. Continued willingness to participate by parents is maximized by: Answering parents' questions about child development and child rearing philosophy, and in some cases referrals to proper help; providing interesting pamphlets and magazine articles for parents to read; providing transportation when necessary; taking ample time to explain the purpose of the project; the importance of avoiding long waiting periods as much as possible by careful scheduling, but making it pleasant for the mother, infant and siblings when waiting was necessary.

   Money payments were not necessary, even though the subjects included the illegitimate babies of four young and very low income mothers.

6. The bare room with a soft rug and a baffle wall conceiling instrumentation was the best of the experimental layouts of those tried in this project.

7. These are the machines considered most satisfactory:

   The one and two panel pressboxes

   The WGTA

   The attention-span box

   Ring and cube discrimination apparatus

These were considered basically good in conception but needed further improvements:

The effort to duplicate the peering design as described by John Watson.

Enclosed cubicles.

Objects attached to the head for measuring purposes

The eyeblink procedure

Mechanical measurement of the head turn

For other than detailed study of the eye blink response measurement by simple observation seemed to be more practical than measuring devices which ential affixing a small electrode or other object to the eyelid. Dr. Burton White expressed the opinion that for broad purposes, observation was adequate with this age group. The involuntary blink rate for infants is less than that for adults and, hence, presents less of a problem.

Analysis of Data

A rank order correlation W program was run for all subjects who had complete data for all for test periods on a given kind of conditioning task.

TABLE 1.

| | W coefficient of correlation | $x^2$ | Degrees of Freedom | p |
|---|---|---|---|---|
| Vocalization | 0.33759 | 31.058 | 23 | <.2 >.1 N.S. |
| Discrimination task | 0.27316 | 21.853 | 20 | <.5 >.3 N.S. |
| Eyeblinks | .39179 | 36.045 | 23 | <.05 >.02 |
| Headturns | .37747 | 28.687 | 19 | <.1 >.05 |

N.S. Not significant

It will be seen that subjects consistency of performance from one test time to another was greatest on eyeblinks and least great on discrimination tasks. It is interesting that eyeblinks might reasonably be expectedto be least subject to voluntary control, least related to I.Q. and least dependent on the design of the task. Discrimination problems, on the other hand, might be expected to be highly related to the task design and to involve I. Q.

A second rank order correlation W program was run for all subjects who had complete data for all tasks at a given test period. Results are shown in Table 2.

TABLE 2

| | W coefficient of correlation | $x^2$ | Deg. of Freedom | p |
|---|---|---|---|---|
| Aged 3 months | .23 | 11.79 | 17 | N.S. |
| Aged 6 months | .11 | 9.6 | 14 | N.S. |
| Aged 9 months | .22 | 19 | 14 | N.S. |
| Aged 12 months | .11 | 13.3 | 16 | N.S. |

These results seem to indicate that subjects lacked consistency of performance on different kinds of conditioning tasks at the same age period. This lack of consistency would seem to suggest that there is not support for the concept of a unitary trait of conditionability which applies to both classical and operant tasks or that our methods failed to measure this trait. It is possible that only the conditioning tasks involving involuntary reflex responses (eyeblink and possibly GSR) would be the best indicant of hereditary components of temperament, if, indeed, any conditioning task can be a measureable indicant. It will be recalled that eyeblink response showed the most subject-consistency.

A program was devised to correlate each of the twenty-four major variables with each of the other 24 major variables. The program used only those subjects who had complete data for each of the two variables being correlated at a given time, so that N for each

correlation differs. Since there were 276 r's, it would be expected that by chance alone 1% (approximately 3) would be significant at the .01 level or better and that 5% (approximately 14) would be significant at the .05 level or better. Actually, more than twice this number were, in each case, significant at these levels. In the case of those significant at the .05 level or better, 34 r's were significant. If r's for the same variable but at a different test time (such as Bayley Mental Development Index at 3 months and at 9 months) are eliminated and if correlations with N less than 3 are eliminated, 24 remain. While one might be mindful of the possibility that chance plays a large part here, in an exploratory work of this kind it is probably reasonable to look closely at all relationships that have possible significance. (See Appendix B)

Table 3. shows r's significant at the .01 and .05 levels.

Table 4. shows all r's.

TABLE 3.

| Correlations significant at the .01 level or better. | p |
|---|---|
| Vocalizations at 3 mo and Discimination Task at 6 mo | <.001* |
| PDI at 3 mo and at 12 mo | <.001 |
| Vocalizations at 3 mo and at 12 mo | <.001 |
| MDI and PDI at 6 mo. | <.01 |
| Discrimination task at 6 mo. and headturns at 12 mo. | <.01 * |
| MDI at 6 mo. and at 9 mo. | <.01 |
| PDI at 6 mo. and eyeblinks at 9 mo. | <.01 |
| Eyeblinks at 9 mo. and at 12 mo. | <.001 |
| Eyeblinks at 9 mo. and PDI at 12 mo. | <.01 |
| MDI at 9 mo and at 12 mo. | <.01 |

MDI Mental Development Index, Bayley Scale
PDI Physical Development Index, Baley Scale
* Negative correlations

Correlations significant at the .05 level or better

Vocalizations at 3 mo and PDI at 3 mo
Vocalizations at 3 mo and PDI at 9 mo.
*Headturns at 3 mo and Eyeblinks at 3 mo.
*Headturns at 3 mo and PDI at 9 mo.
MDI at 3 mo and MDI at 9 mo.
*PDI at 3 mo and WGTA problem at 12 mo
Vocalizations at 6 mo. and Eyeblinks at 6 mo.
Vocalizations at 6 mo and MDI at 6 mo.
*Vocalizations at 6 mo and PDI at 9 mo.
Headturns at 6 mo. and Discrimination Task at 6 mo.
Eyeblinks at 6 mo and MDI at 6 mo.
MDI at 6 mo. and Eyeblinks at 9 mo.
MDI at 6 mo. and MDI at 12 mo.
*PDI at 6 mo. and Vocalizations at 12 mo.
PDI at 6 mo. and panel pushes at 12 mo.
PDI at 6 mo. and MDI at 12 mo.
Eyeblinks at 9 mo. and MDI. at 12 mo.
MDI at 9 mo and PDI at 9 mo.
MDI at 9 mo and panel pushes at 12 mo.
Vocalizations at 12 mo and WGTA proglem at 12 mo.
WGTA problem at 12 mo and PDI at 12 mo.

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Blaine--in his examination of the attention span data found "no correlation of significant degree throughout all of the attentional variables . . . (These results) indicate that measurement of attention span is not a stable measurement with the techniques

used in this investigation."[14] He also found that there seemed to

[14]Blaine, H. Myrate, "The Relationship of Attention Span in a Selected Group of Infants to Performance on a Test of Mental Abilities," University of Alabama, 1971, Unpublished Doctoral Dissertation, p. 51.

be "no significant relationship at the .05 level between mental and motor abilities and attentional behavior."[15]

[15]Ibid., p. 51.

## SUMMARY

This longitudinal study of infant conditionability in the first year of life is most useful as a feasibility study of general organization and design, useful secondly as a feasibility study of twelve conditioning task procedures considered as measuring devices with infants, and yields data which must be considered suggestive only.

It was feasible to test thirty-two infants of varied backgrounds at three months intervals during the first year of life, testing three days at each test-time and using no monetary compensation. It was feasible to administer tests of attention span and the Bayley Scales of Mental and Motor Development at each test time.

The twelve conditioning designs, some based on successful conditioning reported in the literature and some original, were

adapted to the testing situationwith varying success. The Table in Appendix A rates the effectiveness and aversiveness of the designs used.

An examination of the data for this first year shows that only eyeblink conditioning behavior remained consistent to a significant degree throughout the first year. Correlations of measures of conditioning behavior for different kinds of tasks at one test-time were not significantly correlated at any test-time, thus failing to lend support to the concept of conditionability as a unitary trait as tested by these methods.

With twenty-four variables studied, 276 pair correlations were possible. Thirty-four were significant at the .05 level or better.

The theoretical background of the study is H. J. Eysenck's postulate that temperament is related to conditionability. The study is an attempt to determine inherited aspects of temperament through measuring conditionability at an early age. Were such determination possible, differing child rearing strategies and teaching patterns could be devised for different children.

The children's I.Q. and conditioning behavior will be tested again at age 3 years. A personality investory will be administered at age 7 years to see if conditioning behavior in the first year did, indeed, predict temperament. It is hoped that future research and other researchers will polish and standardize the procedures.

APPENDIX B

Three Months

| Day I | Day II | Day III |
|---|---|---|
| Vocalization | Vocalization | Vocalization |
| Attention span | Attention span | Attention span |
| Eye blink | Eye blink | Eye blink |
| Head turn | Head Turn | Head turn |
| Discrimination task | Bayley Test | Bayley Test |

Six Months

| Day I | Day II | Day III |
|---|---|---|
| Vocalization | Vocalization | |
| Attention span | Attention span | Attention span |
| Cube discrimination | Cube discrimination | |
| Head turn | Head turn | Head turn |
| Eye blink | Eye blink | Eye blink |
| | Laugh response | Bayley Test |
| | Bayley Test | |

Nine Months

| Day I | Day II | Day III |
|---|---|---|
| Vocalization | Vocalization | |
| Attention span | Attention span | Attention span |
| Ring discrimination | One panel press box | Laughter |
| Eye blink | Eye blink | Eye blink |
| Head turn | Head turn | Head turn |
| | Bayley Test | Bayley Test |

Twelve Months

| Day I | Day II | Day III |
|---|---|---|
| Vocalization | Vocalization | Eyeblink |
| Attention span | Attention span | Head turn |
| Eye blink | Eye blink | Two panel press box |
| Head turn | Head turn | WGTA |
| | Two panel press box | Laughter |
| | Bayley Test | Bayley Test |
| | | Vocalization |

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